EVN Science Vision
and
Technological Roadmap

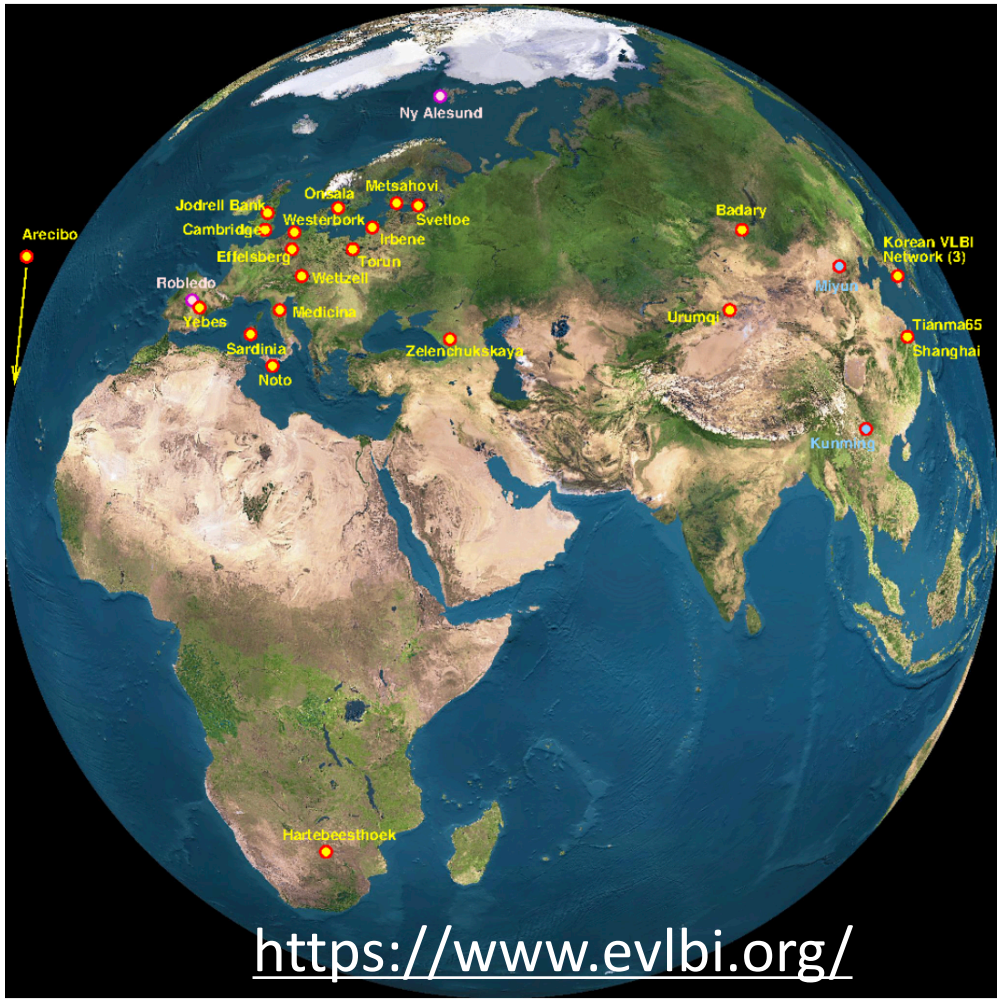
Tiziana Venturi (IRA-INAF, chair EVN CBD)

The EVN: a very sensitive VLBI Network

- **18** European **partners** + China + Russia + South Africa + Korea
- Includes **100m, 64m, 40m, 32m-class dishes**
- **eMERLIN** routinely part of the array
- Arecibo lost – but 12m in progress

EVN correlator at JIVE

- 3 sessions (x 3 weeks) per year + 10 e-VLBI days, + ToO + OoS
- 3 calls for proposals (Feb, Jun, Oct 1)
- Standard observing frequencies in the 1.6/2.3/5-6/8.4/22 GHz bands
- Routinely @2Gbps, moving towards 4 Gbps
- **μJy/b sensitivity at 1.6 GHz and 5 GHz**

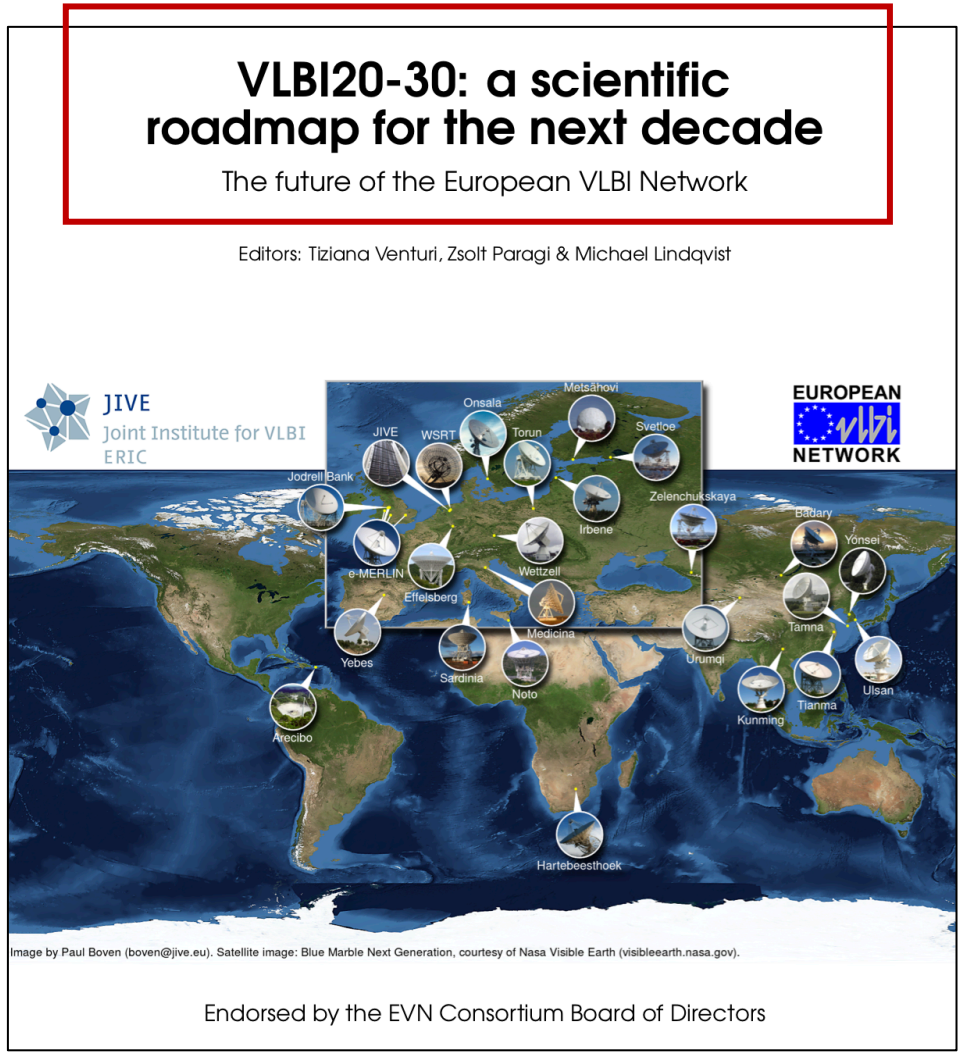


1.6 GHz and 5 GHz observing as strengths of the EVN

Frequency coverage

Telescope	Wavelength (cm) / Frequency (GHz)											Diameter (m)	Bitrate in e-VLBI observations (Gbit/s)
	92.0 / 0.3	49.0 / 0.6	30.0 / 1.0	21.0 / 1.4	18.0 / 1.7	13.0 / 2.3	6.0 / 5.0	5.0 / 6.0	3.6 / 8.3	1.3 / 23.1	0.7 / 42.9		
Arecibo (Ar)				■	■		■	■				305	0.512
Badary (Bd)				■	■		■			■		32	1
Cambridge (Cm, e-MERLIN stations)				■	■		■	■		■		32	0.512
Effelsberg (Ef)				■	■		■	■		■		100	2
Hartebeesthoek (Hh)					■		■	■		■		26	2
Irbene (Ir)					■		■	■				32	2
Jodrell Bank (Lovell, Jb1)				■	■		■					76	2
Jodrell Bank (Mk2, Jb2)				■	■		■	■		■		25	2
Kunming (Km)												40	
KVN-Tamna (Kt)												21	
KVN-Ulsan (Ku)												21	
KVN-Yonsei (Ky)												21	
Medicina (Mc)				■	■		■	■		■		32	2
Metsähovi (Mh)										■		14	1
Noto (Nt)				■	■		■	■		■		32	2
Onsala-60 (O6)										■		20	2
Onsala-85 (O8)				■	■		■	■				25	2
Robledo-34 (Ro)												34	
Robledo-70 (Ro)												70	
Sardinia (Sr)				■	■			■		■		65	2
Svetloe (Sv)				■	■		■			■		32	1
Tianma (T6)				■	■		■	■		■		65	2
Torun (Tr)				■	■		■	■		■		32	2
Urumqi (Ur)												25	
Westerbork (Wb)				■	■		■	■				25	2
Wettzell (Wz)												20	
Yebes (Ys)							■	■		■		40	2
Zelenchukskaya (Zc)				■	■		■			■		32	1

EVN Science Vision and Technological Roadmap



Main purpose: define the role of VLBI in the scientific framework of the next decade, with the new observational facilities in the radio, optical, X- and gamma-ray domains

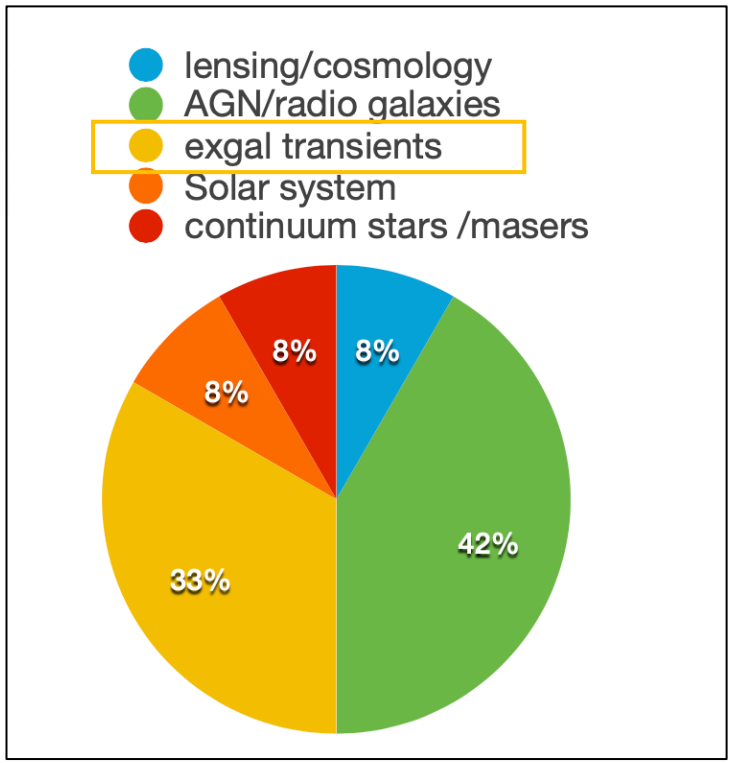
- Great community effort, facilitated by H2020 JUMPING JIVE.

  https://arxiv.org/abs/2007.02347

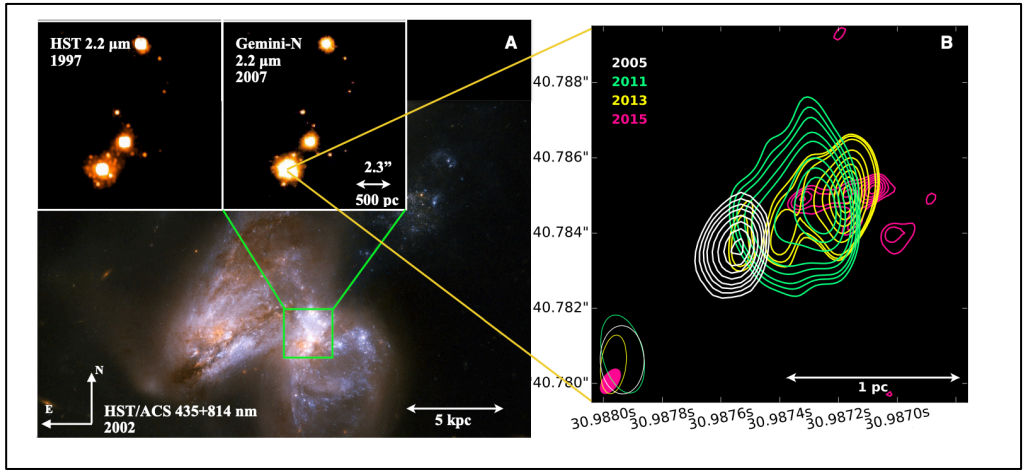
- Main topics:
  1. Cosmology
  2. Galaxy formation and evolution
  3. Innermost regions of AGN
  4. Explosive phenomena, transients
  5. Stars and stellar masers in the Milky Way
  6. Earth and Space

An amazing broadening of the science where VLBI plays a unique role compared to 15 years ago

Examples of key VLBI Science in the next decade

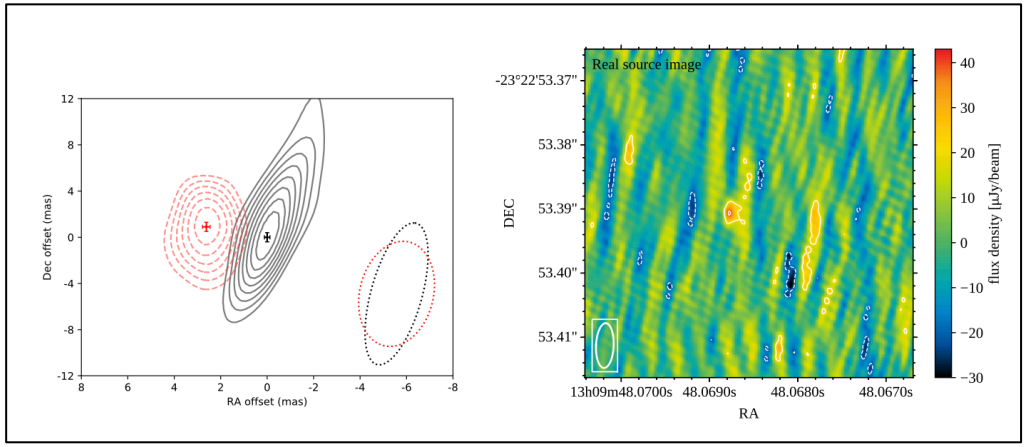


Science distribution of EVN proposals in 2019C. *Courtesy of the EVN PC Chair (Rygl)*



A Tidal Disruption Event in Arp-299 B

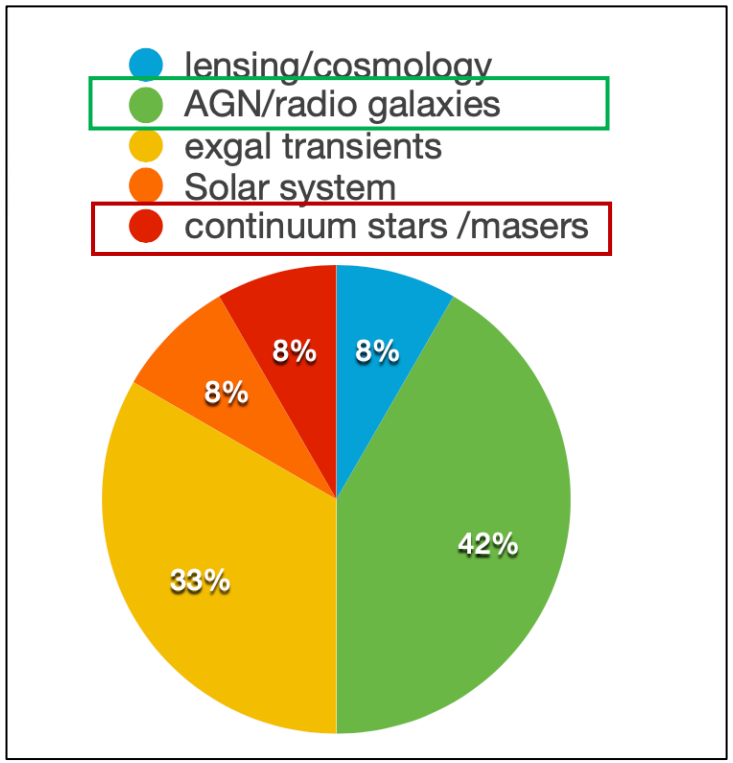
Mattila et al. 2018



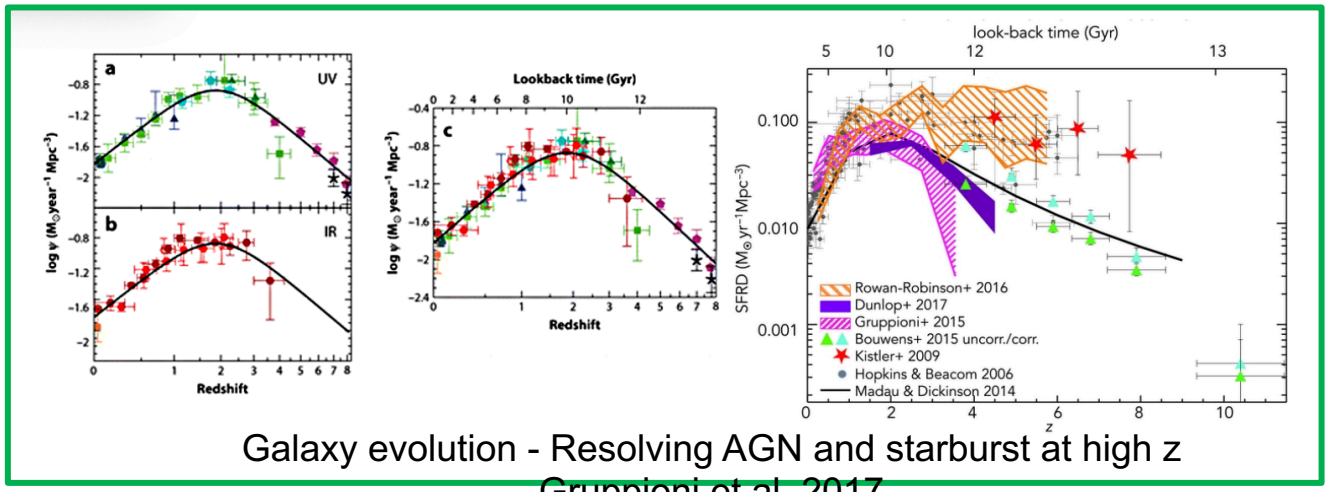
Non-thermal counterpart of GW170817
Jet vs cocoon

Ghirlanda et al. 2019

EVN Science Vision and Technological Roadmap

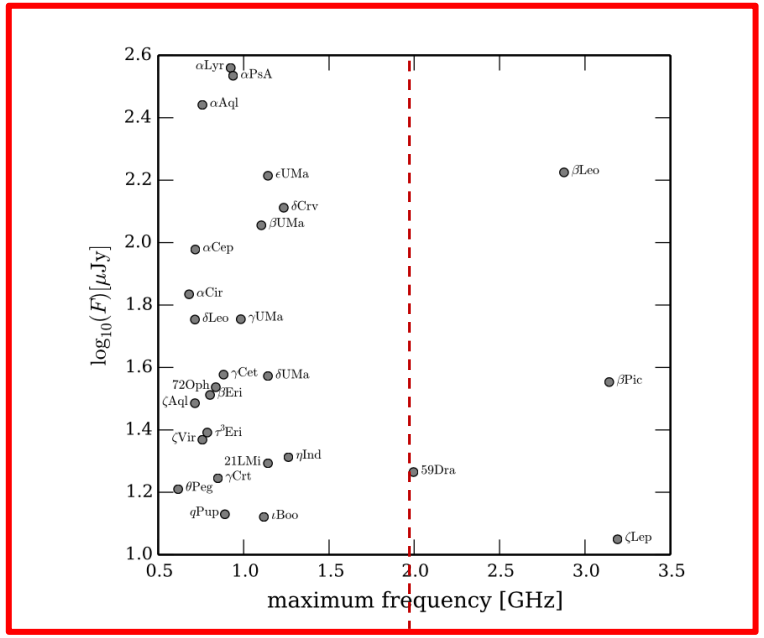


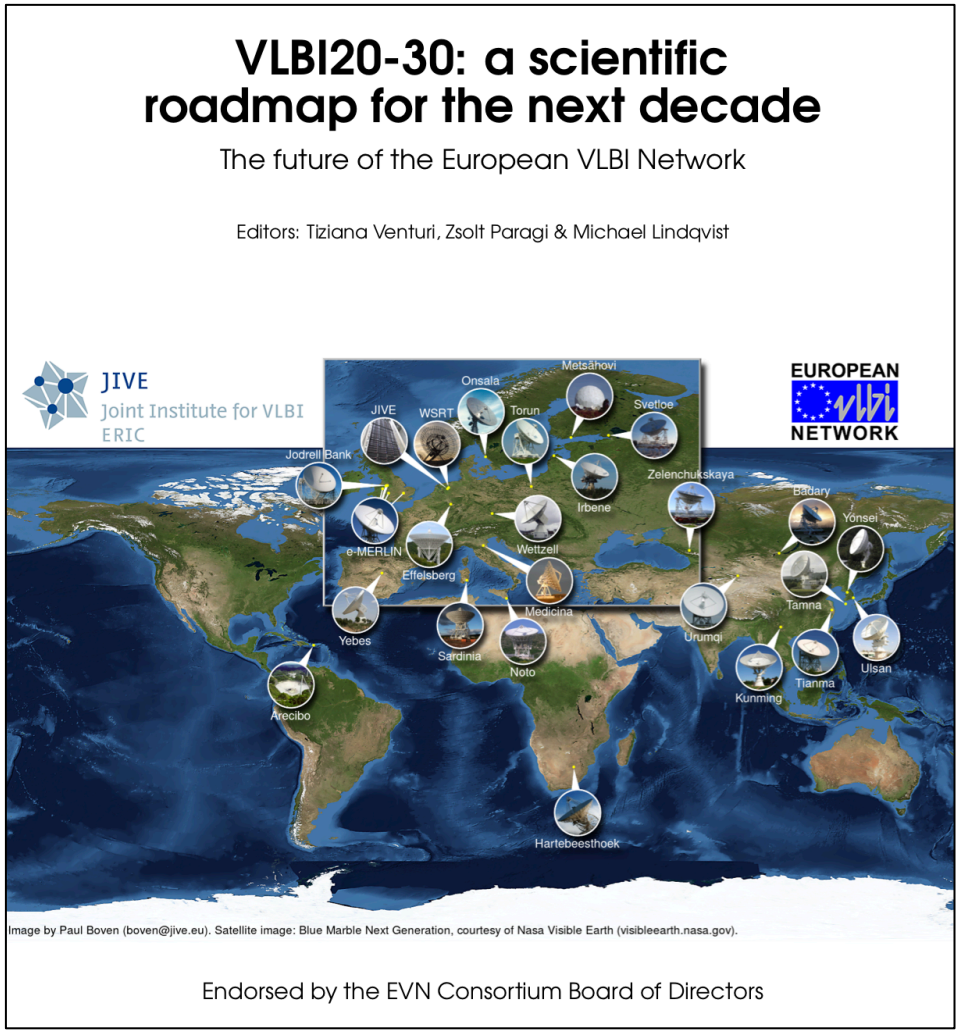
Science distribution of EVN proposals in 2019C. *Courtesy of the EVN PC Chair (Rygl)*



Galaxy evolution - Resolving AGN and starburst at high z
Gruppioni et al. 2017

Expected radio emission from massive exoplanets at 1 AU around A-type stars
Katarzynski et al. 2016





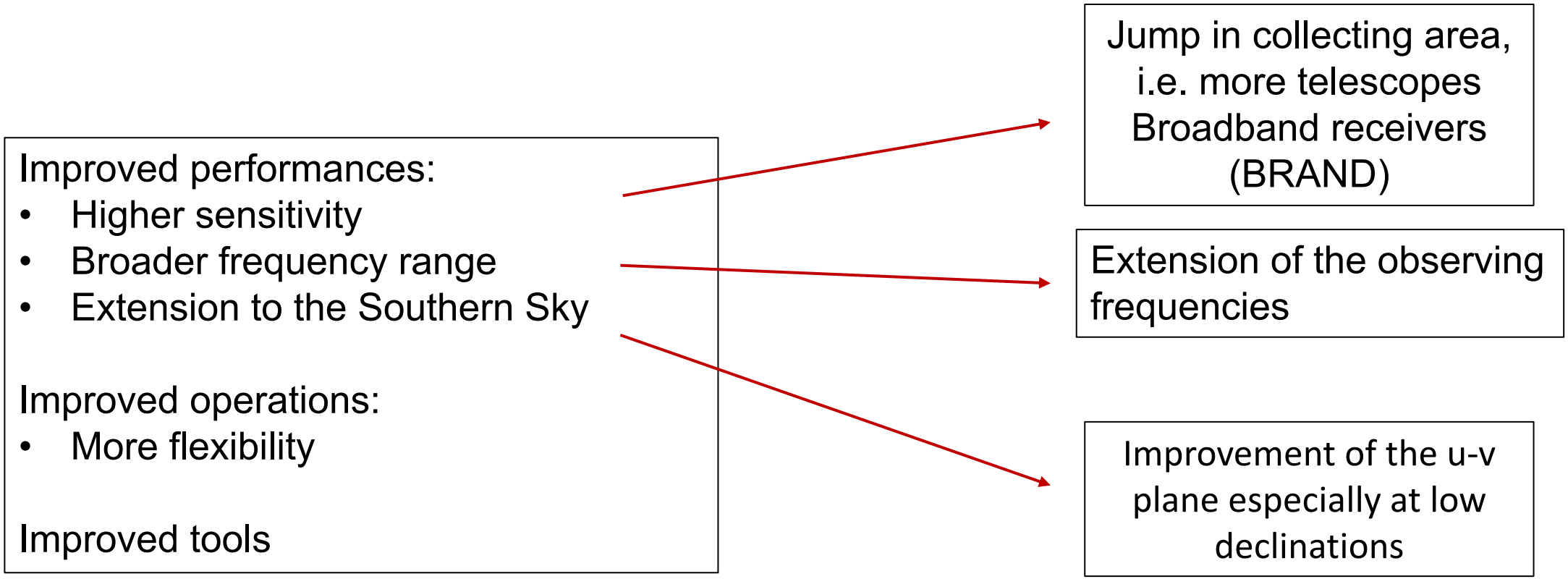
Directions for a technological roadmap

Improved performances:
- Higher sensitivity
- Broader frequency range
- Extension to the Southern Sky

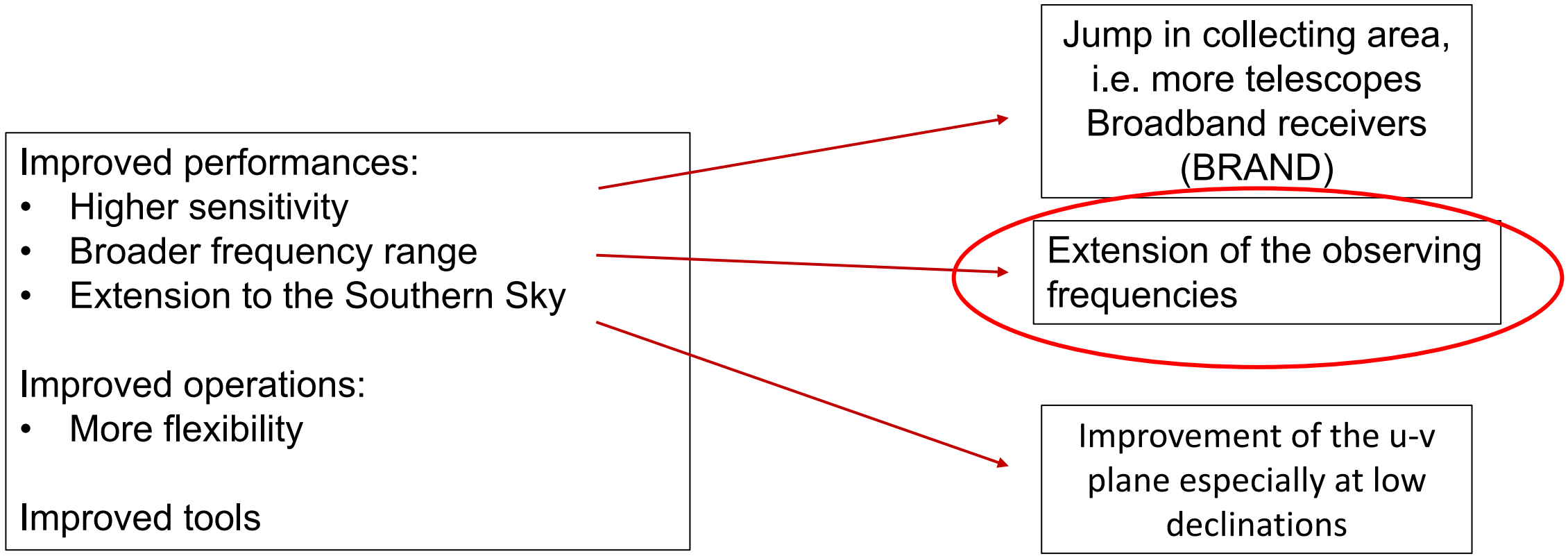
Improved operations:
- More flexibility

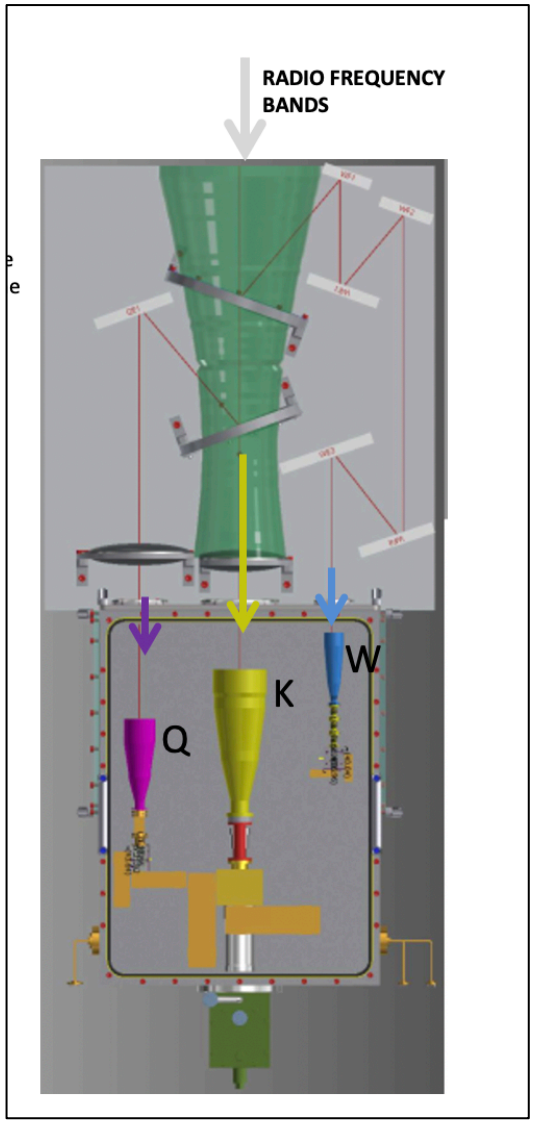
Improved tools

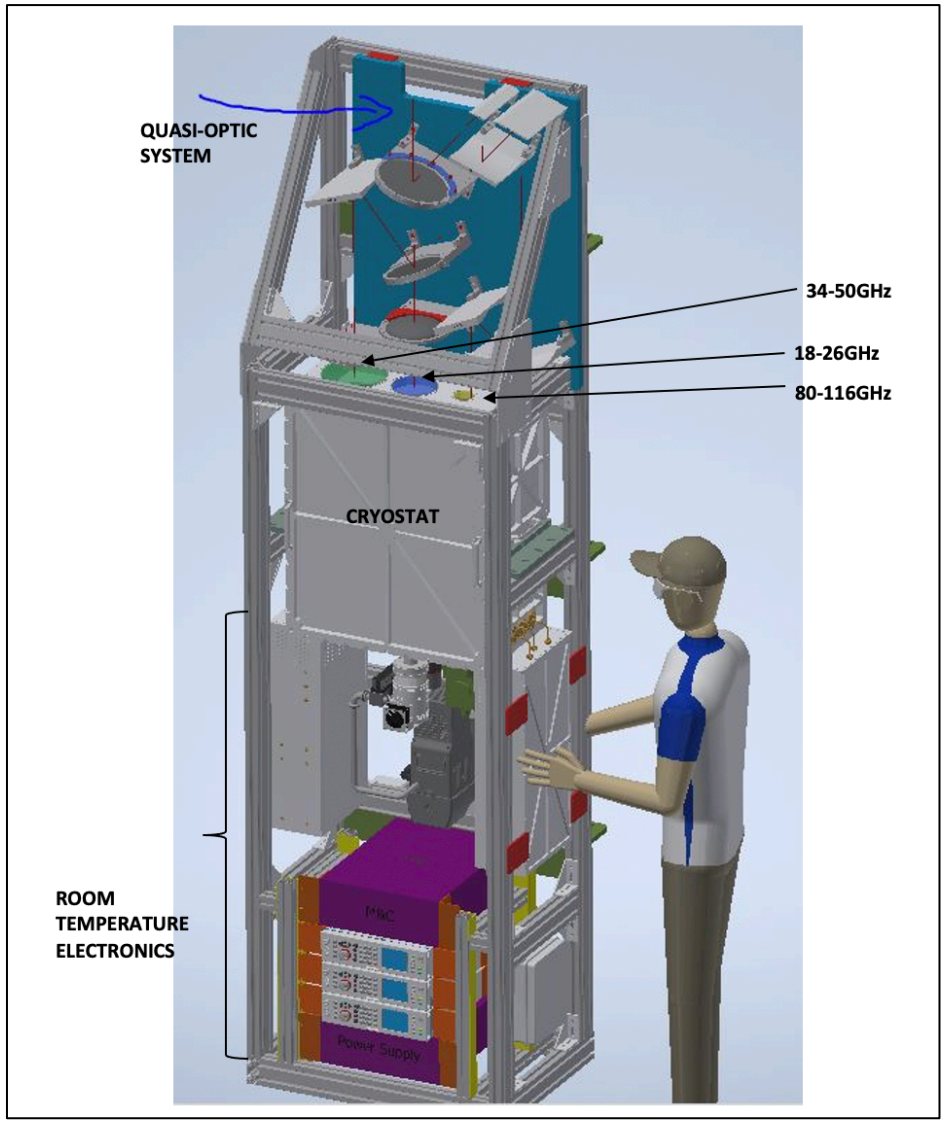
EVN Science Vision and Technological Roadmap



EVN Science Vision and Technological Roadmap







Extension of the observing frequencies

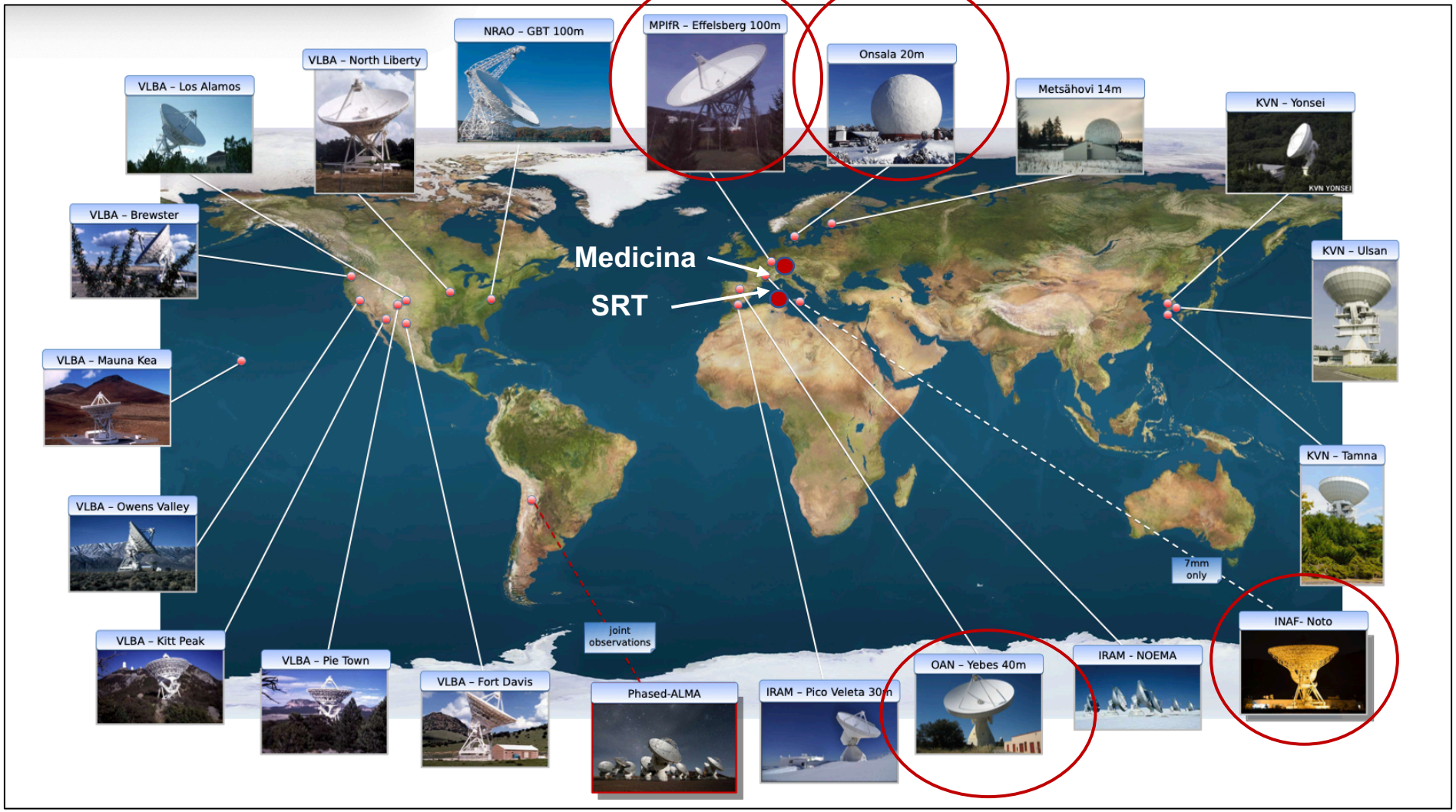
⇩

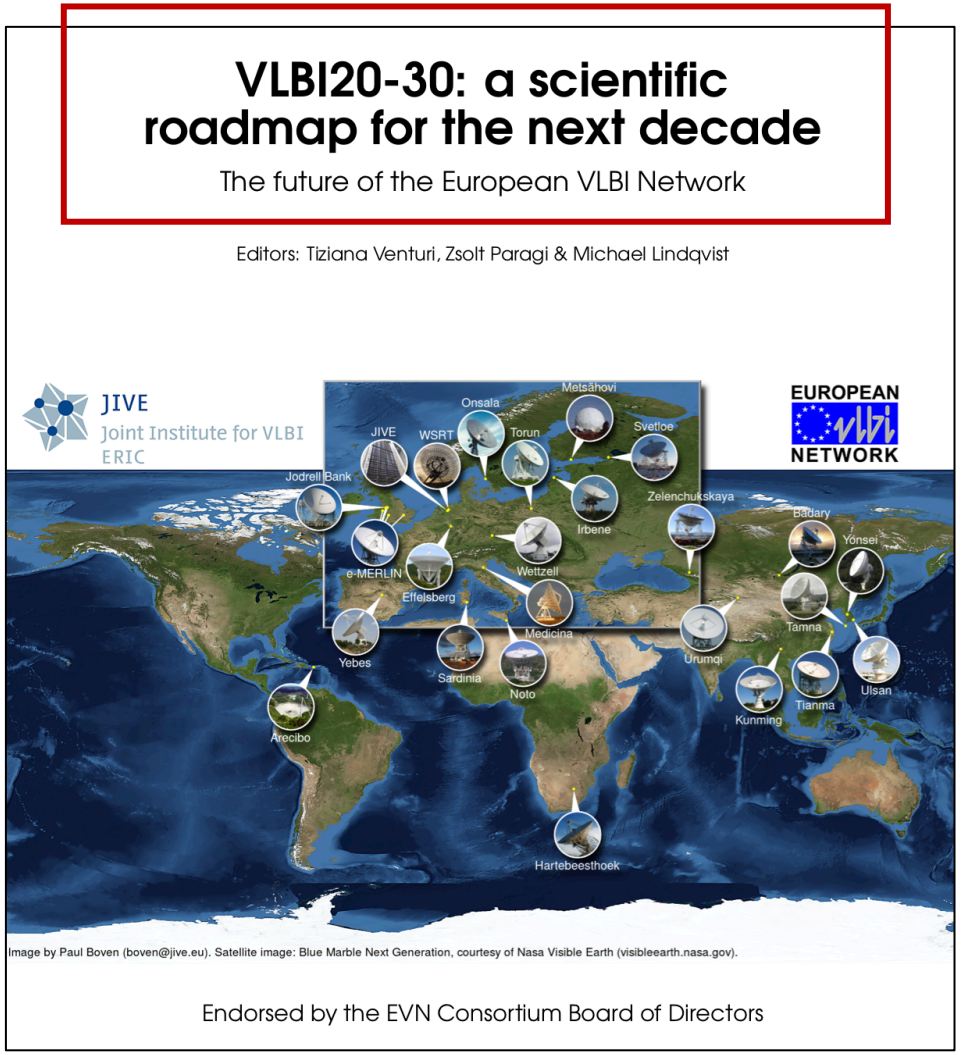
Triband receiver K-Q-W bands

⇩

Mc, Nt and SRT equipped by ~ 2022
Yb, Eb and On have already shown interest

EVN Science Vision and Technological Roadmap

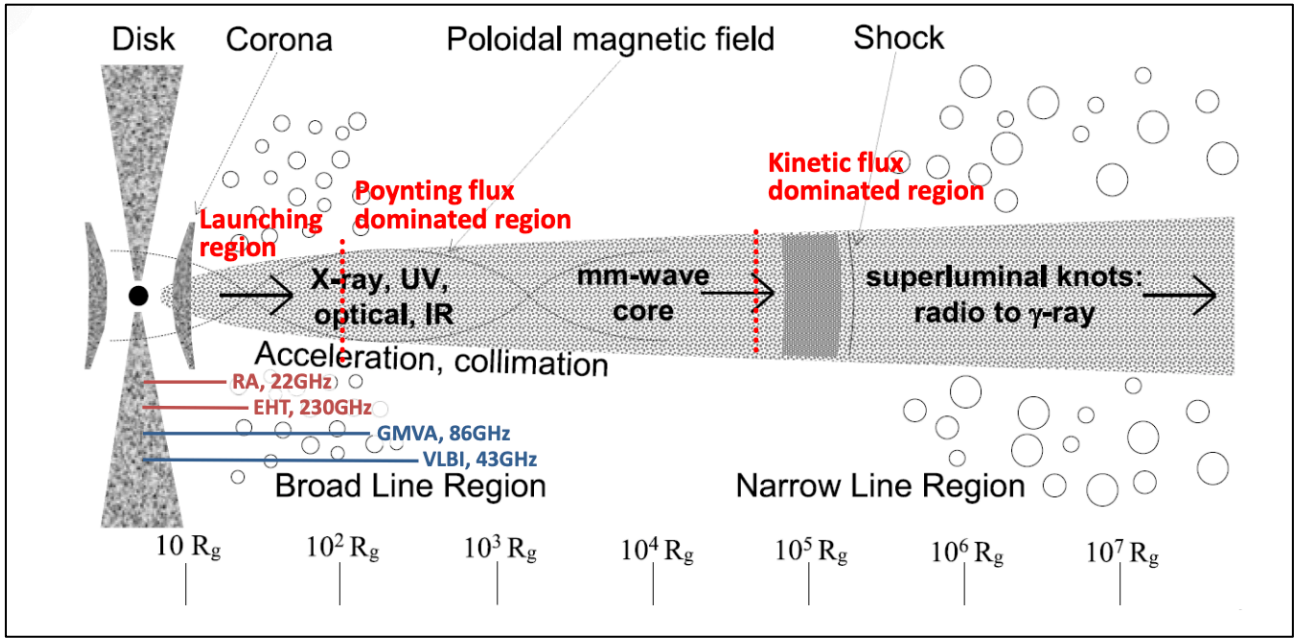




https://arxiv.org/abs/2007.02347

- Main topics:
  1. Cosmology
  2. Galaxy formation and evolution
  3. Innermost regions of AGN
  4. Explosive phenomena, transients
  5. Stars and stellar masers in the Milky Way
  6. Earth and Space

EVN Science Vision and Technological Roadmap



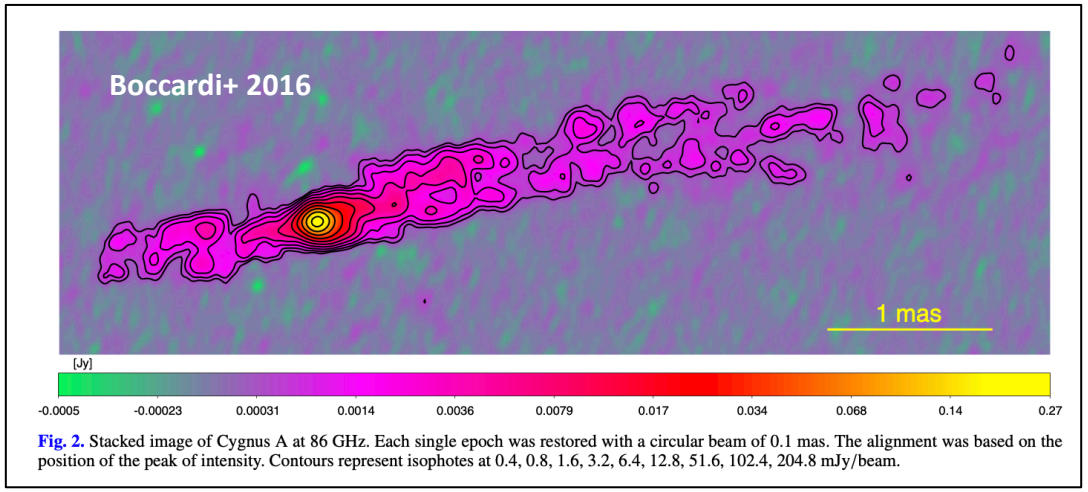
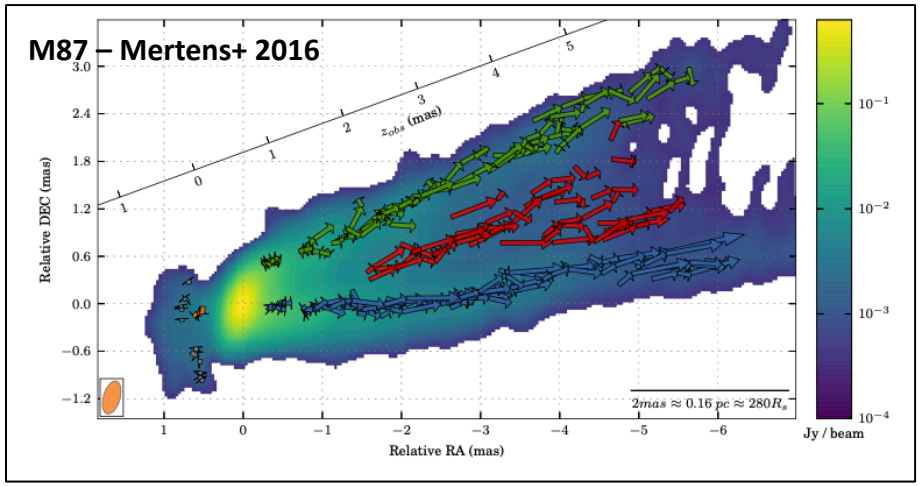
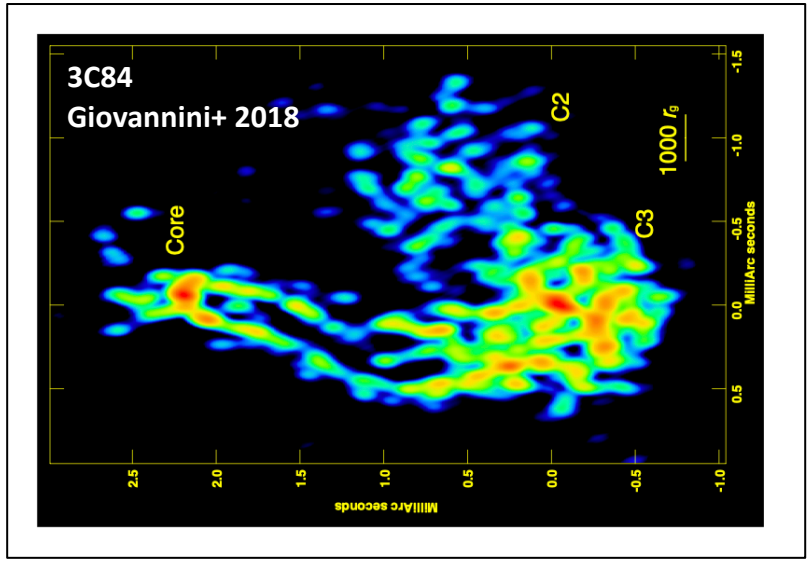


Fig. 2. Stacked image of Cygnus A at 86 GHz. Each single epoch was restored with a circular beam of 0.1 mas. The alignment was based on the position of the peak of intensity. Contours represent isophotes at 0.4, 0.8, 1.6, 3.2, 6.4, 12.8, 51.6, 102.4, 204.8 mJy/beam.



Peering into the inner jet regions of AGN is a key science topic which needs capabilities up to 100 GHz and beyond



Concluding Notes

The EVN Science vision document

- ✓ has clearly shown the impact of VLBI over a very broad range of science with new exciting hot areas
- ✓ has clearly assessed the need for mas to submas angular resolution over a broad range of frequencies in the era of the next generation multiband facilities
- ✓ Is the current reference for the **technological developments** the EVN needs to implement on a medium timescale to face the scientific premises

More in the presentations on GVA (Kobayashi & Colomer) and on SKA-VLBI (Paragi)

EVN Science Vision and Technological Roadmap